

### **Ambient Water Quality Monitoring (AWQM)**

At the core of determining the quality of the Commonwealth's waters are the data generated from the collection and analysis of ambient surface water samples. The Department has a long history of water quality monitoring beginning with the first sample collected in June of 1941. Over the years the focus of monitoring has been guided by various regulatory and assessment needs. With the development and implementation of the Water Quality Monitoring Strategy in 2000, the ambient monitoring program entered a new era of statewide network monitoring that is designed to produce representative, high quality, data. This data supports the evaluation, restoration, and protection of the quality of the Commonwealth's waters for the purposes of fishing, swimming, drinking and the propagation and growth of a balanced, indigenous, healthy ecosystem. The Monitoring Strategy was revised in 2004 and formally accepted by the United States Environmental Protection Agency (USEPA).<sup>1</sup>

In order to achieve this goal, and satisfy scientific, legislative and aesthetic requirements related to the quality of the Commonwealth's aquatic resources, DEQ has established a series of specific objectives to identify and define the diverse functions of the Water Quality Monitoring Program.

#### **Objectives:**

##### **1. Assessment and Remediation Objectives:**

###### **(a) Status Quo Characterizations and Assessments:**

- (1) Provide accurate, representative data for water quality characterization and assessment of all surface waters within the state.
- (2) Establish consistent statewide siting, parameter selection and monitoring techniques, to ensure data reliability and the comparability of data.
- (3) Assure that the frequency of sampling and the total number of observations collected are sufficient to provide adequate data for scientific, statistically based and defensible assessment procedures.
- (4) Assure that, whenever possible, flow rates are determined simultaneously with the collection of water quality data.
- (5) Monitor, according to a plan and schedule, all substances discharged into state waters that are subject to water quality standards or are otherwise necessary to determine water quality conditions.
- (6) Continually evaluate the overall success of the Commonwealth's water quality management efforts.

###### **(b) Impaired Waters / Remediation:**

- (7) Provide data to define the cause, severity and geographic extension of impaired waters:
- (8) Provide adequate data for TMDL model development and validation.
- (9) Provide adequate data, by means of follow-up monitoring, to evaluate the implementation of TMDL's and other best management practices.

###### **(c) Variability, Trend Assessments and Forecasts:**

- (10) Provide adequate data and analytical procedures for short, medium and long-term statistical evaluation of water quality variation and trends within identifiable, geographically defined waterbodies.

##### **2. Permit Objectives:**

- (11) Provide data for the calculation of permit limits for the issuance, re-issuance and/or modification of effluent discharge permits.
- (12) When water quality problems are suspected, provide data to detect and document water

---

<sup>1</sup> Millennium 2000 Water Quality Monitoring Strategy, Virginia Department of Environmental Quality, October 2004.

quality impairments and/or to evaluate permit adequacy, whether permitted dischargers are in compliance with permit limits or not.

### 3. Efficiency Objectives:

(13) Improve the efficiency of the Monitoring Program by minimizing resource requirements and the duplication of efforts, while maximizing the use of integrated data collected within and among state and federal agencies, public utilities, private enterprises and citizens groups for statewide water quality assessments.

(14) Increase the use of biological (e.g., benthic macroinvertebrates, fish, and/or aquatic vegetation assemblages), as well as fish tissue and sediment monitoring for specific assessments of water quality.

(15) Investigate, identify and characterize additional avenues of actual or potential water quality impairment, including ground water contribution and aerial deposition rates.

(16) Guarantee adequate Quality Assurance/Quality Control (QA/QC) procedures to provide precise, accurate and representative water quality data for all purposes.

### 4. Research Objectives:

(17) Provide data to validate special stream or site designations.

(18) Evaluate new methodologies for sampling, analyzing and assessing water quality.

(19) Provide data for other research objectives.

As a result of the implementation of the new strategy a monitoring network of multiple programs and special studies was identified and developed to include the following programs:

**WATERSHED (AW)** DEQ's ambient watershed network of stations represents the largest single section of the monitoring program. Detailed information on the purpose and objectives of these stations and their selection can be found in Section III.B. of the Monitoring Strategy document.

**COASTAL 2000 (C2)** Coastal 2000 is the federally funded tidal probabilistic program designed by USEPA and sampled by VADEQ staff. Grant funding for this program ended in 2006 and has been supplemented by various state and federal funding initiatives.

**CHESAPEAKE BAY (CB)** Chesapeake Bay Program identified in section III.E.1. of the strategy. The design of this program is through the Federal-Interstate Chesapeake Bay Program and encompasses a multi-state water quality characterization effort.

**CITIZEN MONITORING (CM)** These stations are monitored due to specific requests from the public, usually as a result of local concerns. Notification occurs in the fourth quarter of the calendar year with sampling scheduled to begin in the next monitoring year.

**FACILITY INSPECTION (FI)** Facility inspections are not specifically identified in the water quality monitoring strategy but are integral to determining compliance with discharge limits. Specific sample locations are not included in the monitoring plan but only estimated numbers of samples for the purpose of calculating annual budgets.

**FRESHWATER PROBABILISTIC (FP)** The freshwater probabilistic monitoring program covers the non-tidal free-flowing waters of the state. The program is designed to answer the question of what is the overall water quality of the Commonwealth for free-flowing streams.

**FISH TISSUE (FT)** Fish tissue and sediment monitoring program<sup>2</sup> conducted by central office staff from the Office of Water Quality Monitoring and Assessment.

**MERCURY (HG)** Mercury Special Study Program paid for by the responsible parties.

---

<sup>2</sup> Virginia Department Of Environmental Quality, Water Quality Standards, Office Of Water Quality Programs 2001 Fish Tissue And Sediment Monitoring Plan, May 9<sup>th</sup>, 2001.

**INCIDENT RESPONSE (IR)** Incident response samples are the same as PC but are non-petroleum in origin.

**POLLUTION COMPLAINTS (PC)** Pollution complaints are special samples generally collected as a result of a petroleum spill.

**REGIONAL BIOLOGICAL (RB)** Biological monitoring program focuses on the analysis of the benthic macroinvertebrate community as a tool to detect water quality conditions. The methodologies used follow the recently approved Virginia Stream Condition Index (VSCI) and Coastal Plain Macroinvertebrate Index (CPMI) and are described in detail in section III.E.4. of the Monitoring Strategy.

**RESERVOIR MONITORING (RL)** Reservoir monitoring is described in the [Lake Monitoring Guidance](#)<sup>3</sup>

**SPECIAL STUDIES (SS)** Special studies are identified by individual project plans and are specialized intensive targeted monitoring efforts designed to answer specific hypothesis related to water quality conditions.

**TMDL (TM)** TMDL monitoring stations are those stations associated with the development of a TMDL and subsequent implementation plan for segments listed on the 303(d) list.

**TREND (TR)** Trend stations are those long term stations sited for permanent monitoring for the purpose of detecting water quality trends for a wide variety of environmentally important water quality parameters.

**CARRYOVER (TW)** Those stations with insufficient data for assessing and usually are those stations with small data sets during an assessment cycle that indicate a potential problem. These stations are considered carryover stations and will be sampled until sufficient data is available to determine the water quality conditions.

## Data Summary

Between January 2001 and December 2006, DEQ staff collected multiple samples at 5,570 stations. From these stations, the number of independent observations for the common field measurements was 99,178 for temperature, 75,748 for pH, 97,951 for dissolved oxygen, 73,694 for specific conductivity, and 31,881 for salinity. These samples were analyzed for a variety of chemical constituents including nutrients, bacteria, metals, pesticides, herbicides and toxic organic compounds; 195 different parameters were sampled for a total of 436,996 data points.

The number of stations representing a particular type of stream segment, the types of samples collected, the parameters analyzed, and the sampling frequency all vary depending on site conditions and program emphasis. A detailed report of sample locations, matrices, parameters, and frequency is available in the [Annual Monitoring Plans](#).

Each basin summary, found in Chapter 3.2 of this report, lists the ambient water quality monitoring summary data within the basin. Summaries of the sampling data collected at each station during the reporting period are provided in Appendix A of this report and can be found on the DEQ water website at <http://www.deq.virginia.gov/wqa/>.

**Contact:** For further information on the Ambient Monitoring Program contact:

Roger E. Stewart  
629 East Main Street  
Richmond, Virginia 23219  
**(804) 698-4449**  
[restewart@deq.virginia.gov](mailto:restewart@deq.virginia.gov)

---

<sup>3</sup> Lake Monitoring Guidance, Virginia Department of Environmental Quality, December 1999.  
Revised in 2002  
Final 2008

## **Freshwater Benthic Macroinvertebrate Monitoring Program**

Virginia's freshwater biological monitoring program began in the 1970's to fulfill requirements of the Federal 106 Grant agreement. DEQ uses benthic macroinvertebrate communities to assess the ecological health of freshwater streams and rivers. Benthic macroinvertebrates are larger than microscopic invertebrate organisms such as insects, crustaceans, snails, mussels and worms that inhabit stream bottoms.

Biological monitoring, using benthic macroinvertebrates, is an invaluable tool for evaluating the temporally integrated, overall effects of the water and sediment quality in streams and rivers. Benthic macroinvertebrate communities integrate water quality through time and the effects of different pollution stressors, providing a holistic measure of their aggregate impact, including antagonism and/or synergism among chemical and physical pollutants. Because of their sedentary nature, macroinvertebrates are good indicators of localized conditions. Most species have a complex life cycle of approximately one year or more and integrate the effects of fluctuations in water quality over time which conventional water quality surveys may miss. In essence, benthic macroinvertebrates are considered to be virtual "living recorders" of water quality conditions over time. The structure and functioning of macroinvertebrate communities are extremely sensitive. These communities may exhibit responses to water quality pollutants for which specific criteria or standards have not been defined, chemical analyses are not normally performed or tolerance is below chemical detection limits.

DEQ's biological monitoring program examines over 150 stations annually. Reasons for bioassessments can include targeted monitoring, probabilistic monitoring, tracking local pollution events, follow-up on waters of concern identified through volunteer citizen monitoring and TMDL monitoring. Data from the biological monitoring program are used for periodic review and assessment of state waters as required by Section 305(b) of the Clean Water Act. Biological monitoring is one tool used for assessing the aquatic life designated use of state waters established in 9 VAC 25-260-10 A. that states in part, "All state waters, including wetlands, are designated for the following uses: .....the propagation and growth of a balanced, indigenous population of aquatic life, including game fish, which might reasonably be expected to inhabit them....." .

DEQ uses two bioassessment indices to assess the biotic integrity in non-tidal freshwater streams and rivers in Virginia. In the Coastal Plain, which is characterized by low gradient streams east of the fall line, the Coastal Plain Macroinvertebrate Index (CPMI) methodology is used. This multimetric index was developed in 1997 by the Mid-Atlantic Coastal Streams (MACS) workgroup. The CPMI is a multimetric bioassessment index which was calibrated for low gradient Coastal Plain streams which exhibit different benthic macroinvertebrate communities from non-coastal stream communities.

For non-coastal streams, assessment of the benthic macroinvertebrate community is based on the Virginia Stream Condition Index (VSCI). The VSCI was developed for Virginia freshwater non-coastal streams by USEPA's contractor Tetra Tech, Inc. Using historical data collected in Virginia at reference and stressed streams from 1994-1998, Tetra Tech compared the historical data against additional data collected from 1999-2002. The VSCI is based upon recent advances in bioassessment methods contained in "*Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers, Second Edition*" (Barbour et al. 1999). The VSCI, a multimetric calculation of benthic integrity converted into a single numerical score, resulted in a single reference condition for the entire non-coastal portion of the Commonwealth against which all future benthic samples will be compared. The development of this index is considered a significant step in the advancement of the biomonitoring program to address a wide range of monitoring and assessment needs. Based on recommendations from public comment and the Academic Advisory Committee, the VSCI was validated using a spatially diverse (ecoregionally and stream size) data set free of pseudoreplication. These probabilistic data sets have allowed DEQ to narrow data gaps and test the VSCI against many classification variables and confirm with certainty, the VSCI is a good assessment tool for Virginia streams.

**Contact:** For further information on the Freshwater Benthic Macroinvertebrate Monitoring Program contact:

Aimee J. Genung  
629 East Main Street  
Richmond, Virginia 23219  
**(804) 698-4046**  
[aigenung@deq.virginia.gov](mailto:aigenung@deq.virginia.gov)  
Final 2008

## **Estuarine Probabilistic Monitoring Program (Coastal 2000/National Coastal Assessment)**

Virginia's estuarine probabilistic monitoring module was initiated in the summer of 2000 with a five-year grant (CR-828544-01 – period 2000-2004) from EPA's "National Coastal Assessment (NCA) Program", formerly known as the "Coastal 2000 Initiative". This original, five-year effort was defined under the terms of a proposal titled "Monitoring the US Atlantic Coast: Assessing Virginia's Estuaries and Tidal Tributaries to the Chesapeake Bay and the Atlantic Ocean", submitted to the US-EPA in the spring of 2000. Specific field methodologies and Quality Assurance requirements of the Coastal 2000 / National Coastal Assessment Program are described in the EPA documents "[National Coastal Assessment Field Operations Manual](#)" (EPA 620/R-01/003) and "[National Coastal Assessment Quality Assurance Project Plan 2001-2004](#)" (EPA/620/R-01/002).

### **Purpose:**

The original goals of the National Coastal Assessment (Coastal 2000) Program were to:

- Assess the ecological condition of estuarine resources,
- Determine reference conditions for ecological responses/stressors, and
- Build infrastructure in EPA Regions and participating states.

Additional, more specific federal objectives were to:

- Assess the health or condition of the estuarine waters of the United States and track changes in that condition through time,
- Assess the health or condition of the estuarine waters of the various coastal states and track changes in that condition through time,
- Utilize the approach to identify reference conditions for estuarine waters in the United States, and
- Utilize existing state monitoring programs as appropriate

The geographic extent of the Estuarine/Coastal ProbMon Program is restricted to the eastern-most regions of the state. It is coordinated through the DEQ Central Office in Richmond and is carried out primarily by the Piedmont (PRO - Glen Allen) and Tidewater (TRO - Virginia Beach) Regional Offices. A small proportion of the estuarine probabilistic sites fall within the geographic jurisdiction of the Northern Virginia Regional Office (NVRO) in Woodbridge; however due to the small number of sites involved (maximum of 1 or 2 sites annually), and logistical and training considerations, PRO assumes the primary responsibility for sampling while NVRO personnel may accompany and aid them in the field.

At the state level, the Virginia DEQ defined its agency goals and objectives relative to its comprehensive statewide Water Quality Monitoring (WQM) Program. Each participating DEQ region (PRO & TRO) needs to complete its assigned probabilistic stations in order for DEQ to reach defensible conclusions about overall estuarine water quality from a statewide perspective.

### **Monitoring Design (Site Selection, etc.):**

The sampling strata for tidal tributaries have been geographically defined, by estuary size and drainage location, and a set of randomly selected sampling sites have been provided annually by the EPA/ORD Gulf Ecology Division (GED) Laboratory in Gulf Breeze, Florida (2000-2004), or the Atlantic Ecology Division (AED) Laboratory in Narragansett, Rhode Island (2005-2007) upon request.

The two principal sampling strata in the state design consist of (1) small tidal tributaries to the Chesapeake Bay and its major tributaries and (2) tidal tributaries and embayments of the Atlantic coast and Back Bay/North Landing River (which discharge into Pamlico/Albemarle Sounds, North Carolina). The major tidal tributaries to Chesapeake Bay (the Potomac, Rappahannock, York and James Rivers), as well as the Bay mainstem, are effectively characterized by the probabilistic monitoring of Virginia's Chesapeake Bay Program. Periodically (2000 and 2005-06), these larger waters are also included in the NCA sampling design for the purpose of integration into the standardized National Coastal Assessment (NCA) Program.

In the first year of sampling, 35 sites were selected in Virginia's portion of the Chesapeake Bay mainstem and the tidal portions of its major tributaries (Rappahannock River, York River, James River, & Final 2008

Elizabeth River - the tidal portions of the Potomac River mainstem are entirely in the state of Maryland). In order to better characterize smaller estuarine subdivisions, DEQ has in subsequent years (2001-2004) emphasized, and will continue to emphasize, minor tidal tributaries to the Chesapeake Bay, the Atlantic Ocean, and to Pamlico/Albemarle Sound by sampling at 50 sites annually. Virginia's participation in the interstate Chesapeake Bay Program already provides adequate probabilistic monitoring for the characterizations of the Chesapeake Bay mainstem and its major tidal tributaries (e.g., lower Potomac, James, York, and Rappahannock Rivers). The "weighting" of the current sampling design guarantees that each year approximately 70% of the sites (~35 stations) are selected in the Chesapeake Bay drainage and approximately 30% (~15 sites) are selected in coastal drainages. Additionally, it assures that a minimum of approximately 70 sites will be available to characterize the coastal estuary resource class by the end of each six-year period.

### **Core and Supplemental Water Quality Indicators:**

From 2001 through 2006, with the resources provided by EPA NCA/Coastal 2000 Grants, estuarine probabilistic stations were sampled for the complete suite of parameters described in the National Coastal Assessment QAPP cited above, as well as additional parameters utilized by the Chesapeake Bay Program. The total suite of water column parameters includes profiles of temperature, pH, DO, salinity and Photosynthetically Active Radiation (PAR), as well as samples for chlorophyll, nutrients and suspended solids measurements at near-surface, mid-depth and near-bottom. In addition, homogenized sediment samples are collected for local (DCLS) analyses of particle size and total organic carbon (TOC), as well as for metals and organic contaminant analyses and toxicity testing at EPA-contracted laboratories. A separate, 0.04 m<sup>2</sup> sediment sample is collected and sieved in the field for later identification of macroinvertebrate benthic infauna species to complete the "Sediment Quality Triad" (SQT) for "weight-of-evidence" ecological evaluations and assessments. EPA Grant funds have also provided for the contracting of the Fisheries Science Laboratory at the Virginia Institute of Marine Science (VIMS) for fish trawls. These trawls were used to collect fish community-structure data, epibenthic organisms, incidental fish for pathological examinations, and targeted fish species for the analyses of metals and organic contaminants in whole fish. Beginning in the summer of 2003, DEQ started supplementing the NCA core indicators with additional sampling for bacteria (fecal coliform, E. coli, and enterococci) and when resources permitted for dissolved trace metals.

Sample handling and shipping varies with the type of sample and its final destination for analysis. All samples are collected from boats anchored at the monitoring sites and are appropriately labeled and stored on wet ice at 4° C during transport to the responsible DEQ Regional Office. Samples to be analyzed at the Virginia State laboratory (DCLS) are maintained on ice and shipped daily to Richmond by overnight courier service. Such samples are received and processed within 24 hours of collection. Analyses are completed within the holding time specified in the pertinent QAPPs and EPA analytical method descriptions, after which the resultant data is entered into the DCLS LIMS system. Analytical results are subsequently transmitted to and permanently stored in the DEQ CEDS 2000 database on a daily basis. Turnaround time from sample arrival at DCLS to receipt of analytical data varies from 48 hours to 21 days, depending upon sample type.

Sediment samples that are to be analyzed chemically and toxicologically by EPA-contracted laboratories are held under refrigeration at DEQ Regional Offices and are shipped to Richmond by courier on a weekly basis. Samples from the previous week are united and shipped via overnight air to the EPA Gulf Ecology Division (EPA/GED) laboratory at Gulf Breeze, FL, from where they are redistributed to the appropriate contracted laboratories. Benthic infauna samples are preserved in (10%) buffered formalin as soon as they are collected and are maintained at DEQ Regional Offices until the end of the field season (early October). They are united at the DEQ Central Office and shipped to EPA/GED for subsequent transshipment (2000-2004) or are shipped to the Benthic Ecology Laboratory at Old Dominion University (ODU) (2005-2006). Turnaround time for the receipt of analytical results from EPA-contracted laboratories varies from one year to two years or more, depending upon sample type and EPA QA/QC procedures prior to the relay of data to DEQ. The results from benthic analyses performed at ODU are normally available the following spring.

Data, related to fish community structure, epibenthic invertebrates and habitat collected by VIMS trawl sampling, are immediately entered into their onboard SAS database during the process of collection. Target fish species selected for chemical tissue analyses are individually labeled and wrapped and maintained on ice during transport to the laboratory. Once there, they are frozen and maintained until the end of the field season (October). They are shipped overnight, on dry ice, to EPA/GED for storage and later transshipment. Fish pathology specimens are maintained in Dietrich's solution until the end of the field season and are subsequently shipped to EPA/GED. Fish community, epibenthic macroinvertebrate and

Final 2008

habitat data are united into a final report which VIMS sends to DEQ soon after the end of the field season in October or early November. Turnaround time for fish tissue chemical data and fish pathology data from EPA-contracted laboratories is currently at least two years.

### **Frequency/Duration:**

As is typical of probabilistic survey programs, monitoring sites are sampled only once, after which new sites are randomly selected each of the following year(s). Under the conditions defined by the NCA QAPjP, sampling occurs during the summer months from 1 July through 30 September. This period also coincides with the sampling “window” defined for the use of the Chesapeake Bay Program’s [“Benthic Index of Biological Integrity”](#) (B-IBI), which is utilized to evaluate the ecological health of the benthic community.

DEQ’s Estuarine Probabilistic Monitoring Program was proposed and developed as a major component of the agency’s Ambient Water Quality Monitoring Program and is fully implemented at this time. The resources formerly provided by the initial EPA Coastal 2000 Grant facilitated the implementation of the program in 2000 and terminated at the end of September 2004. A transitional National Coastal Assessment Grant provided funding at a reduced level during the 2005-2006 interim. Beginning in 2007, DEQ has continued the Estuarine ProbMon Program with a slightly reduced suite of parameters using supplemental probabilistic monitoring funds from federal §106 grants, complimented by Chesapeake Bay and general fund resources.

### **Quality Assurance Measures:**

DEQ’s field and laboratory activities adhere to QA/QC protocols specified in the [National Coastal Assessment Field Operations Manual](#) (EPA 620/R-01/003) and the [National Coastal Assessment Quality Assurance Project Plan 2001-2004](#) (EPA/620/R-01/002), except where specific variations have been authorized by the Regional NCA QA Officer. Authorized departures include the use of submerged pumps and hoses for the collection of subsurface water samples and vacuum field-filtration of nutrient and chlorophyll samples. Both of these procedures are specifically described in the corresponding sections of the contemporary QAPjP and SOPs for Virginia’s Chesapeake Bay Monitoring Program.

DEQ requires that a minimum of 10% QA samples (field duplicates, field blanks, etc.) be collected at estuarine ProbMon field sites for all locally analyzed parameters. At present, two to three QA sites are randomly selected annually per DEQ Regional Office, from among the 50 sites sampled (10-12%).

### **Data Management:**

Both samples and the resultant data collected within the National Coastal Assessment Program follow diverse pathways. Standard procedures for the transportation and delivery of samples to the Virginia Division of Consolidated Laboratory Services (DCLS) and of sample shipment to EPA/ORD/GED at Gulf Breeze, FL have been described above.

The data flow and data management for water and sediment samples analyzed by DCLS follow pathways and turnaround times as described for the WQM Program in general. Analytical results are quality assured by DCLS and stored in their LIMS database. Results that are complete and certified there are subsequently shipped electronically to the DEQ FTP site for upload into the CEDS 2000 database on a daily basis.

Currently, all data from locally (DCLS) analyzed samples reside in DEQ’s CEDS 2000 database. The turnaround time from receipt of samples at the laboratory until data arrives in the database varies from 48 hours to 21 days depending upon sample type. All analytical results receive a QA review at DCLS, prior to shipment to the DEQ database, and another QA review by programmed algorithms (data range screenings, etc.) within the CEDS database. Data that are ‘flagged’ by the automated screening procedures undergo an additional evaluation by DEQ’s QA Officer. Whatever questions arise concerning the location, date and time of samples arriving at DCLS, or about the accuracy of DCLS data transmitted to the CEDS database are resolved immediately via e-mail and voice communication between laboratory personnel and monitoring personnel at the DEQ Central or appropriate Regional Office.

### **Looking to the Future:**

The National Coastal Assessment Program (Coastal 2000 Initiative) was instituted by EPA’s Office of Final 2008



Research and Development (ORD) as an experimental program in 2000. The original five-year program was so successful and so well accepted by the participating coastal states that it is currently being transferred to EPA's Office of Water (OW) as a permanent component of its national water quality monitoring strategy. An interim two-year grant supported the program (at a reduced level) during the 2005-2006 transition. After that, the program has received partial support via the normal § 106 federal grant process.

Beginning in the summer of 2005, portions of this program were coordinated with and integrated into the Chesapeake Bay Program's (CBP) probabilistic benthic monitoring program. Probabilistically-collected sediment-related parameters (sediment chemistry, sediment toxicity and benthic community structure – the 'Sediment Quality Triad' or SQT) from the minor tidal tributaries will supplement CBP efforts in the major tidal tributaries and mainstem of Chesapeake Bay. Use of the SQT will facilitate the characterization and aquatic life use assessment of these minor tidal tributaries, where sample sizes are generally insufficient to apply the formal statistical assessment method utilized for the Benthic Index of Biological Integrity (B-IBI) in larger Chesapeake Bay assessment units (segments).

EPA currently plans to carry out national probabilistic surveys on various aquatic resource classes on a five-year rotational basis. The next National Coastal Survey is scheduled for planning and preparation in 2009 with field sampling in 2010. Hopefully, an influx of additional federal resources at that time (and at five-year intervals thereafter) will permit the periodic expansion of the parameter suite and geographic coverage of VA-DEQ's Estuarine Probabilistic Monitoring Program.

**Contact:** For further information on the Estuarine Probabilistic Monitoring Program contact:

Donald H. Smith, Ph.D.  
Virginia Department of Environmental Quality  
629 East Main Street  
Richmond, Virginia 23219  
**(804) 698-4429**  
[dhsmith@deq.virginia.gov](mailto:dhsmith@deq.virginia.gov)



## **Estuarine Benthic Macroinvertebrate Monitoring Program**

Benthic organisms are important secondary producers, providing key linkages between primary producers (phytoplankton) and higher trophic levels (crabs, bottom feeding fish and water birds). Benthic invertebrates are among the most important components of estuarine ecosystems and may represent the largest standing stock of organic carbon in the Chesapeake Bay. Benthic organisms, such as hard clams and soft-shell clams, are economically important. Others, such as polychaete worms and shrimp-like crustaceans, contribute significantly to the diets of economically important blue crabs and bottom-feeding juvenile and adult fish such as spot, croaker, striped bass, and white perch.

The objectives of the Chesapeake Bay Estuarine Benthic Macroinvertebrate Monitoring Program are:

1. To characterize the health of regional areas of the lower Chesapeake Bay as indicated by the structure of the benthic community.
2. To conduct trend analyses on long-term data, at fixed- point stations, to relate temporal trends in the benthic communities to changes in water and/or sediment quality. The trend analyses will be updated annually as new data are available.
3. To warn of environmental degradation by producing an historical data base that will allow annual evaluations of biotic impacts by comparing trends in status within probability-based strata and trends at fixed-point stations to changes in water and/or sediment quality.

21 fixed-point stations are sampled one time per year (September) and there is one probabilistic summer sampling per year.

**Contact:** For further information on the Estuarine Benthic Macroinvertebrate Monitoring Program contact:

Rick Hoffman  
629 East Main Street  
Richmond, Virginia 23219  
**(804) 698-4334**  
[fahoffman@deq.virginia.gov](mailto:fahoffman@deq.virginia.gov)

## **Fish Tissue and Sediment Monitoring Program**

DEQ monitors concentrations of chemical contaminants including heavy metals and organic pollutants in fish and shellfish tissue in order to assess the human health risks for individuals who may consume fish from state waters. Additionally, sediment samples are also collected at each sampling station and are analyzed for the same pollutants. The sediment data are used to help locate a source of pollution where the fish tissue data indicate a concern. The sediment data are also used to identify potentially impaired aquatic ecosystems.

In the fish tissue monitoring program, a two-tiered sampling strategy is followed which is consistent with federal guidance for fish tissue contamination monitoring programs.

Tier I is a screening study of a relatively large number of sampling stations to identify sites where concentrations of contaminants in the edible portions of fish indicate potential health risks to human consumers. Sediment samples are also collected to assess whether stream sediments are contaminated to a degree that poses a potential for aquatic ecosystem impairment. Tier I stations are selected using a rotational river basin approach of all the river basins in Virginia. Until 1996, approximately 25-30 stations were selected among two river basins each year as the routine monitoring. The Code of Virginia § 62.1-44.19.5 (WQMIRA) requires maintenance of the 1996 level of tissue and sediment sampling which equates to a minimum of 24 fish sampling stations per year. Since 1996 the following number of stations have been sampled for fish and sediment; 1997 (43 stations), 1998 (54 stations), 1999 (58 stations), 2000 (72 stations), 2001 (96 stations), 2002 (98 stations), 2003 (74 stations), 2004 (93 stations), 2005 (94 stations), and 99 stations in 2006. A variable number of some additional stations were sampled for sediment each year.

Several criteria are used to select the sampling stations and include correspondence with the DEQ Waste Division to identify contaminated waste sites that may impact tissue and sediments in aquatic environments. Additional selection criteria include regional office recommendations, extensive literature searches, important recreational and/or commercial fisheries (Department of Game and Inland Fisheries, 1996), close proximity to point source discharges and coverage of the entire watershed, i.e. headwater as well as higher order streams. Routinely, a minimum of three species of fish (top level predator such as a largemouth bass, mid-level predator such as a bluegill, and a bottom feeder such as catfish) are collected at each station. Edible filets from five to ten adult specimens of each species are composited into one sample, resulting in a minimum of three tissue samples per station. Depending on availability of additional funds and variability of species available, four or five species may be sampled at some stations.

Tier I analytical results for fish tissue are expressed in wet-weight and are compared to fish tissue values that are computed using EPA risk assessment techniques for non-carcinogenic and carcinogenic effects. The fish tissue values are calculated based on the same toxicity values and assumptions for average fish consumption rate, body weight and an acceptable cancer risk of one in one hundred thousand ( $10^{-5}$ ) that were used in calculating the Virginia water quality criteria designed for the protection of human health from consumption of contaminated fish. These fish tissue values represent the fish tissue concentration that the water quality criteria are intended to protect against. Occasionally, additional pollutants are sometimes detected in fish tissue for which Virginia does not have water quality criteria or the toxicological information on the chemical has been revised and the water quality criterion has not been updated yet. In this case, an updated fish tissue screening value is calculated and used to assess the data.

Analytical results for contaminants in sediments are expressed in dry-weight and are compared in freshwater to the Consensus-Based Probable Effects Concentrations (PECs) and in salt and estuarine waters to the Effects Range-Median (ER-M) screening values as provided by the National Oceanic and Atmospheric Administration. PECs and ER-M are used to assess the potential effects of sediment contamination to aquatic life. Specific contaminants can be found in Appendix E of the 2008 Assessment Guidance Manual at the DEQ website <http://www.deq.virginia.gov/wqa/>.

For additional information and data from previous years of sampling visit the DEQ website at <http://www.deq.virginia.gov/fishtissue/>.

If tier I results indicate problems may exist, then a second more intensive tier II study is initiated to determine the magnitude and geographical extent along with potential source(s) of contamination in the fish and/or sediment.

The program fulfills the Clean Water Act § 106 United States Environmental Protection Agency Final 2008

(EPA) grant requirements for the collection of fish tissue and sediment. Data generated by the program are used by the Virginia Department of Health to determine the need for fish consumption advisories and/or bans. Data are also used by the DEQ and other state and federal agencies to assess the environmental quality of Virginia's waters. The following is a list of those compounds analyzed.

**Metals:**

Aluminum  
Antimony  
Arsenic  
Cadmium  
Chromium  
Copper  
Lead  
Mercury  
Nickel  
Selenium  
Silver  
Thallium  
Zinc

**Pesticides:**

Aldrin  
Dieldrin  
Endrin  
DDT  
DDE  
DDD  
Chlordane  
Heptachlor  
Heptachlor epoxide  
Hexachlorobenzene  
Methoxychlor  
Nonachlor  
Dicofol  
Triclosan-methyl  
Endosulfan (alpha)  
Endosulfan (beta)  
Polychlorinated biphenyls (PCBs)  
Toxaphene  
Benzene hexachloride (alpha)  
Benzene hexachloride (beta)  
Lindane or Benzene hexachloride (gamma)  
Benzene hexachloride (delta)  
Chlorpyrifos-methyl  
Mirex  
Oxychlordane  
Pentachloroanisole  
Polybrominated diphenyl ethers (BDEs)  
Polychlorinated terphenyls (PCTs)

**Other Organics:**

Acenaphthene	Diethylphthalate	Total PAHs
Acenaphthylene	Dimethylphthalate	Benzo(e)pyrene
Anthracene	Fluoranthene	Benzo(b)fluoranthene
1,2-Benzanthracene	Fluorene	Benzo(a)anthracene
Benzo(a)pyrene	Indeno(1,2,3-cd)pyrene	Benzo(g,h,i)perylene
3,4-Benzofluoranthene	Naphthalene	Benzo(l)fluoranthene
Benzo(k)fluoroanthene	4,6-Dinitro-2-methylphenol	Dibenzodioxin
1,1,2-Benzoperylene	N-Nitrosodiphenylamine	Dibenzofuran
4-Bromophenyl phenylether	N-Nitroso-di-N-propylamine	Biphenyl
4-Chloro-3-methylphenol	Phenanthrene	Diphenyl
2-Chloronaphthalene	Bis(2-ethylhexyl)phthalate	
4-Chlorophenolphenyloether	Butylbenzylphthalate	
Chrysene	Di-N-butylphthalate	
Dibenzo (a,h) anthracene	Di-N-octylphthalate	
3,3-Dichlorobenzidine	Pyrene	
2,4-Dimethylphenol	1,2,4-Trichlorobenzene	

**Contact:** For further information on the Fish Tissue and Sediment Monitoring Program contact:

Gabriel Darkwah  
629 East Main Street  
Richmond, Virginia 23219  
**(804) 698-4127**  
[gadarkwah@deq.virginia.gov](mailto:gadarkwah@deq.virginia.gov)

# **BEACH Monitoring Program - Virginia Department of Health (VDH)**

## **Introduction**

The “Beaches Environmental Assessment and Coastal Health (BEACH) Act” of 2000 amended Section 303 of the Federal Water Pollution Control Act (33 U.S.C. 1313) by specifying monitoring and reporting requirements for pathogens and pathogen indicators in coastal recreational waters for the purpose of protecting public health and welfare. An additional requirement of this Act was the publication of a list of “discrete coastal recreation waters adjacent to beaches or similar points of access that are used by the public.” The resultant “[National List of Beaches](http://www.epa.gov/ost/beaches/list/list-of-beaches.pdf)” [http://www.epa.gov/ost/beaches/list/list-of-beaches.pdf] (already outdated) was first published by the U.S. EPA in March of 2004. A current list of the beaches monitored in Virginia is available and cited below. The requirements of the BEACH Act apply only to states and tribes that have coastal recreational waters, defined by the Clean Water Act (Section 303(c) as the “...Great Lakes and marine and estuarine coastal waters that are designated by a state or tribe for use for swimming, bathing, surfing, or similar water contact activities...”

Within the Commonwealth of Virginia, the Division of Environmental Epidemiology (DEE) of the Virginia Department of Health (VDH) initiated the Beach Monitoring Program for Virginia in 2002. In addition to the immediate reporting requirements and public notices relative to swimming advisories, results obtained by the VDH are communicated to DEQ for inclusion in the agency’s biennial 305(b)/303(d) Water Quality Assessment Reports. The specific 305(b) assessment methodologies for using (1) swimming advisories and/or (2) the enterococci concentration data from the BEACH Monitoring Program were discussed by VDH and DEQ. The final decision on appropriate methodologies is incorporated into the 2008 Assessment Guidance Manual for the Integrated 305(b)/303(d) Report.

The BEACH Monitoring Program for Virginia is designed to provide seasonal monitoring coverage of coastal and Chesapeake Bay beaches within the Commonwealth. A public bathing beach is defined by the Code of Virginia (1980, c.428, section 10-217, 10.1-705) as “a sandy beach located on a tidal shoreline suitable for bathing in a county, city or town and open to indefinite public use.” Based on these characteristics, forty-seven public beaches were identified prior to December of 2003, by which time their locations were communicated to EPA for the National List of Beaches. As of July 2004, a total of 47 Virginia beaches were being monitored by the BEACH Program [VDH Beach Monitoring](#). Currently, 44 beaches in Virginia are being monitored by the BEACH Program. Sampling at three beaches was discontinued due to limited public access at those beaches; the BEACH Act applies to public beaches only. The rationale for identifying and enumerating individual beaches is discussed below, in the section on ‘siting.’ The localities participating in this program include the cities of Virginia Beach, Norfolk, Hampton, Newport News, and Yorktown, as well as King George County, Gloucester County and Northampton and Accomack Counties on the eastern shore of Virginia.

## **Purpose**

Monitoring of beaches is conducted to protect human health. Weekly monitoring is conducted to determine if levels of indicator bacteria (enterococci) meet the criteria of the State Water Quality Standards.

## **Monitoring Design and Station Siting**

The number of sampling stations at a beach is based on EPA guidance available in PDF format from the following web page: <http://www.epa.gov/waterscience/beaches/grants/guidance/index.html>. The rationale for siting and enumerating individual beaches is based on beach size and whether (1) it is small and is treated as a single entity for swimming advisories, or (2) if it is more extensive and individual sections may be closed independently. In summary, the current list of responsible health districts and beaches includes:

Rappahannock Health District (Fairview Beach) - 1 beach  
Peninsula Health District (Newport News, Yorktown) - 5 beaches  
Hampton City Department of Health - 2 beaches  
Norfolk Department of Public Health - 9 beaches  
Virginia Beach (24 miles long) - 22 beaches  
Three Rivers Health District (Gloucester Point) - 2 beaches

Eastern Shore Health District - 3 beaches

Total = 44 beaches

Samples are taken in the middle of a typical bathing area. If the beach is short, samples are taken at a point corresponding to each lifeguard chair or one sample for every 500 meters of beach. (Sample results from several sites in the same beach unit may be united into a single arithmetic average for comparison with the Water Quality Standard and evaluation for swimming advisories - see below.) If the beach is long (more than 5 miles) samples are spread out along the entire beach (e.g., Virginia Beach, which is 24 miles long, has 22 sampling stations spaced at least one mile apart). Locations of sites are identified by coordinates of latitude and longitude and remain uniform from year to year in order to maintain a permanent, long-term database on beach water quality.

The most updated information relative to the BEACH Monitoring Program, including maps of many of the specific sampling sites, the most recent bacterial count results, and a list of swimming advisories, may be found at [VDH Beach Monitoring](#).

### **Frequency**

Beaches are sampled for indicator bacteria on a weekly basis from mid-May through September. When the Water Quality Standard at a specific beach is exceeded, or when the results of bacterial analysis are inconclusive, follow-up sampling is repeated as soon as possible.

### **Sampling**

As per EPA guidance, samples are collected in water knee deep (approximately 0.5 meters), and 0.3 meters below the surface. The VDH Beach Monitoring Protocol provides general guidelines for sampling procedures (as well as orientation on data averaging and the interpretation of results and on issuing and lifting swimming advisories). Samples are maintained refrigerated on 'wet' ice and are delivered to the laboratory for processing within six hours of collection.

Samples are collected on the regular monitoring day, rain or shine, unless conditions are dangerous to sampling staff. (If a decision is made not to sample because a violation of the standard is expected [e.g., heavy storm drain overflow], the beach is posted with a swimming advisory.) Samples are collected and transported in the same way at all sites. The sites are approached on foot and sampled from the beach. All the samples are grab samples, using sterile bottles that are supplied by the laboratory doing the bacterial analysis.

Whenever the Water Quality Standard is violated at a site, Dr. Charles Hagedorn of the Department of Crop and Soil Sciences at Virginia Polytechnic Institute and State University is sent supplemental samples for bacterial source tracking. Fluorometric studies are also performed on these supplemental samples to determine contamination by human versus animal fecal matter. In addition, Dr. Hagedorn's enterococci results, using both the Membrane Filtration (MF) and Enterolert (MPN – Most Probable Number) methodologies, are subsequently compared to results from the local laboratories using the same method.

### **Duration**

Beach monitoring sites are considered permanent, fixed sites of the VDH Beach Monitoring Program. Sampling will continue as long as funding is available. As mentioned above, the sampling is conducted from mid-May through the September swimming season.

### **Core and Supplemental Water Quality Indicators**

The indicator organism used for estuarine and marine beaches is enterococci. Laboratory analysis of enterococci levels in beach water samples is conducted using EPA approved methods. Beach monitoring stations are specifically sampled for enterococci. Additional measurements of air and water temperature, dissolved oxygen, pH and salinity are taken at each of the beach sites during each visit.

### **Quality Assurance**

A Quality Assurance Project Plan was approved by EPA Region 3. As mentioned above, the Final 2008

Virginia Department of Health provides uniform guidance for sampling procedures, as well as orientation on data averaging and the interpretation of results and on issuing and lifting swimming advisories. The general SOP used for field sampling is Standard Methods, 9060, Samples Collection, 20th Edition (pp. 9-19 through 9-21). More specific SOPs for laboratory analyses of bacterial (enterococci) samples are produced by the individual laboratories performing the service (e.g., the Newport News Waterworks SOP for the Enterolert methodology). As previously mentioned, an additional effort to maintain QA/QC consists of collecting grab samples from each site with bottles supplied by the same laboratory doing the subsequent bacterial analysis.

There is an annual Quality Assurance/Quality Control training program, conducted by the Beach Monitoring Coordinator, for all field personnel and their supervisors. Training is given in operating and calibrating equipment, the proper way to collect samples, and how to fill out lab forms for clarity, consistency and completeness. Additional training is provided on how to troubleshoot and correct equipment malfunctions and how to report results. In-the-field training is also given at the same time.

## **Data Management**

The VDH Division of Environmental Epidemiology (DEE) received weekly data reports by e-mail from each local health department on the same day they received the results from their respective laboratories until 2007. DEE personnel aggregated the data on an Excel spreadsheet as soon as they were received and posted beach monitoring and swimming advisory data on the VDH Beach Monitoring webpage. Beach monitoring data and swimming advisory data were then stored in an Access database. Since 2007, beach sampling personnel in local health departments enter sampling results into a secure online database (the Beach Monitoring and Notification Database) through VDH's intranet system. The Beach Monitoring and Notification Database is maintained by DEE. Should sampling results indicate an exceedence of the water quality standard for enterococcus group bacteria and a swimming advisory is issued by the local health department, then swimming advisory duration information is also entered into the online database by the local health department. Timely data submission is emphasized so that the VDH Beach Webpage can be updated as soon as data are available. This is especially true when swimming advisories have been issued. Currently, DEE personnel query the online database for the most recent sampling and swimming advisory results reported by the local health districts and export the results in .html format for immediate posting to the VDH beach monitoring web page <http://www.vdh.virginia.gov/Epidemiology/dee/beachmonitoring/>.

Until 2007, data were periodically sent to EPA, via CDX for STORET, in an XML schema specified in the data user's guide (Beach Monitoring Data User Guide, EPA-823-R-03-004, May 2003). Since 2007, EPA has indicated that they wish to receive data submissions to STORET in a new XML schema and through a new exchange program, WQX. Beach monitoring data are submitted to EPA, via WQX for STORET in an XML schema specified by EPA and described in the data user's guide (Water Quality Exchange (WQX) XML Training Manual, December 2006). Beach swimming advisory data is submitted to EPA via CDX for PRAWN in an XML schema specified by EPA and described in the data user's guide (Beach Data User Guide for Notification Schema v2.0, November 2007). EPA has indicated that they wish to receive the data on a yearly basis, by January 31. Initially, VDH sent 2003 bacteria monitoring data to EPA at the same time that they provided general program information on beach locations, beach extents, state and local beach monitoring contacts, beach advisory authorities, monitoring data fields, and swimming advisory fields, in December of 2003. This information was submitted to meet the original grant requirements. BEACH monitoring and swimming advisory data is currently maintained in VDH's Beach Monitoring and Notification Database and EPA's STORET and PRAWN databases.

## **Data Analysis/Assessment**

*Swimming Advisories:* The VDH compares measured bacterial concentrations with the Virginia Water Quality Standard for enterococci. The results from several simultaneously collected samples at the same beach unit may be united into a single arithmetic average for comparison with the Standard, and for subsequent evaluation for issuing swimming advisories. The single sample, Instantaneous Standard concentration for enterococci is 104 colony forming units (cfu)/100ml. Samples above this level are in violation of the Virginia Water Quality Standards. A single violation of the instantaneous standard is sufficient to issue a swimming advisory for the beach in question.

If there is a violation of the Standard, the local health department contacts the locality in which the

Final 2008



beach is located to inform them of the advisory and the beach is posted with a swimming advisory sign. A press release is issued to notify the public, and a follow-up water sample is taken and delivered to the lab as soon as possible. Specific procedures for this process are documented in the VDH Beach Monitoring Protocol.

*305(b)/303(d) Assessment and Reporting:* The specific 305(b) assessment methodologies for using (1) swimming advisories and/or (2) the enterococci concentration data from the BEACH Monitoring Program was discussed by VDH and DEQ. As previously stated, the final decision on appropriate methodologies is incorporated into the DEQ Assessment Guidance Manual for the 2008 Integrated 305(b)/303(d) Report.

## **Reporting**

If bacteria levels exceed the Water Quality Standards, the beach is posted with a swimming advisory sign and the public is notified through press releases to local newspapers and posting of results on the VDH web page <http://www.vdh.virginia.gov/Epidemiology/dee/beachmonitoring/>.

The results of swimming advisories and all bacterial data collected by the BEACH Monitoring Program are communicated to DEQ for use in the agency's biennial Integrated 305(b)/303(d) Report.

## **Programmatic Evaluation**

The BEACH Monitoring Program for Virginia participates in monthly conference calls with EPA Region III during the swimming season, i.e., May through September, which revert to bi-monthly conference calls during the off-season. The Beach Monitoring Program is grant funded, and reviews of the yearly proposals, progress reports, and database submissions are mechanisms for programmatic evaluation by EPA. Within VDH, there are monthly Beach Monitoring conference calls between the Division of Environmental Epidemiology and the participating health districts, and weekly reviews of data from each participating health district by the Division's Statistical Analyst and Database Manager and the Assistant Beach Monitoring Coordinator for Virginia.

## **General Support and Infrastructure Planning**

The BEACH Monitoring Program is a federally funded program. Yearly budgets are prepared well in advance to meet proposal submission deadlines established by EPA. VDH has received an annual grant to conduct the Beach Monitoring Program for Virginia since December 2002. Future changes in methodologies will depend upon EPA recommendations, and expansion of the current program may occur in response to the opening of new public beaches or their identification by local health districts.

**Contact:** For further information on the BEACH Monitoring Program contact:

Dan Dietrich  
Division of Environmental Epidemiology  
Office of Epidemiology  
Virginia Department of Health  
Madison Bldg., Suite 418C East  
109 Governor Street  
Richmond, Virginia 23219  
**(804) 864-8141**  
[daniel.dietrich@vdh.virginia.gov](mailto:daniel.dietrich@vdh.virginia.gov)



## **Citizen and Non-Agency Water Quality Monitoring Program**

Citizen water quality monitoring has been a stewardship activity in Virginia for many years. As both the volume and quality of water monitoring data collected by entities other than the Virginia Department of Environmental Quality (DEQ) has increased, so has the desire by many of these 'non-agency' organizations for DEQ to use submitted data for more than background information in Virginia's water quality assessments. Since 1999, the agency has encouraged citizen water quality monitoring by providing technical and, whenever possible, financial support. In addition to support for citizen monitoring, the agency has been actively attempting to expand our partnerships with an increasing number of other water quality monitoring programs that operate independently of DEQ.

Starting with the 2004 water quality assessment report, DEQ began using chemical monitoring data collected by citizen groups and other non-agency sources provided such data met DEQ Quality Assurance and Quality Control (QA/QC) protocols for determination of attainment of Water Quality Standards. This QA/QC process confirms whether citizen organizations and other non-agency data sources are using the same or similar sampling and testing methods that DEQ uses, ensuring that comparable data are used in any applications that include data from these sources.

In August 2004, DEQ created the Water Quality Data Liaison staff position to continue to provide guidance and technical support to citizen monitoring organizations, facilitate communication among citizen and non-agency organizations that monitor water quality, promote additional monitoring efforts, and increase the amount and improve the quality of data that are shared with DEQ for assessment consideration.

### **Citizen Monitoring:**

Citizens of the Commonwealth monitor streams, lakes, and estuaries for a variety of parameters depending upon the goals of their own programs. Common ambient measures include many of the following physical and chemical parameters: water temperature, pH, dissolved oxygen, nutrients (various forms of nitrogen and phosphorus), or suspended solids in the water column. Biological parameters measured by citizen monitors often include benthic macroinvertebrates, E. coli bacteria, or chlorophyll *a*. Many of these parameters are also routinely monitored by DEQ.

The Virginia Save Our Streams Program of the Virginia Division of the Izaak Walton League of America (VA SOS) took the lead in working with DEQ and the Department of Conservation and Recreation (DCR) to develop a statewide citizen monitoring program. This started with three separate Letters of Agreement signed by each agency in 1998 and was followed by a three-way agreement signed in 1999. The latest version of the Agreement, signed in October 2006, includes the Alliance for the Chesapeake Bay, Virginia Citizens for Water Quality and the Virginia Water Monitoring Council in addition to the original signatories from 1999.

Citizen monitoring efforts in Virginia received an additional boost in 1999 when the Virginia General Assembly approved a budget amendment to create the Citizen Water Quality Monitoring Grant Program in order to provide general funds, when available, for citizen monitoring activities. Since 1999, the Citizen Monitoring Grant Program has provided funding to over 70 different organizations. The financial support provided by the Commonwealth, via this grant program, has led to an increase in the quality and quantity of citizen-collected data submitted to DEQ and has proved an effective way for DEQ to encourage citizen volunteer groups to generate DEQ-approved water quality data. The grant requires recipients to submit Quality Assurance Project Plans (QAPPs) and to follow DEQ approved procedures. In return, the grant recipient receives a grant award to help cover many of the costs associated with their monitoring programs.

In 2002, the Virginia General Assembly passed legislation that established the Virginia Citizen Water Quality Monitoring Program in the Code of Virginia (§ 62.1-44.19:11). This legislation was later amended in 2007 under House Bill 1859 to establish a goal for DEQ to encourage citizen volunteers to monitor 3,000 stream miles by 2010.

### **Quality Assurance:**

Currently, DEQ has contacts with approximately 130 citizen monitoring organizations. Of these, 94 groups submitted water quality data for review and consideration for use by DEQ in this assessment. Final 2008

Though not all citizen monitoring data submitted could be used in this assessment report, all citizen-generated data are important to DEQ and help to characterize the quality of Virginia's waters.

Data used in this report were collected under documented protocols, standard operating procedures, and QA/QC methods as approved by DEQ for water quality assessment. Data, where the exact sampling location could not be confirmed by DEQ, were not used in this assessment. Data collected by citizen volunteers not used directly for this assessment report will still be used by DEQ and other agencies to help prioritize future monitoring and restoration work. Additional information associated with assessing citizen monitoring data is available in the 2008 Water Quality Assessment Guidance Manual found on the DEQ website: <http://www.deq.virginia.gov/wqa>.

In October 2007, the 2003 *Virginia Citizen Water Quality Monitoring Methods Manual* was revised in order to assist citizen monitoring organizations with developing their monitoring programs. The manual provides additional guidance on acceptable QA/QC procedures and protocols. A copy of this manual is available on the DEQ website: <http://www.deq.virginia.gov/cmonitor/guidance.html>.

As outlined in the *Virginia Citizen Water Quality Monitoring Methods Manual*, DEQ has three levels to determine the quality of citizen and other non-agency water monitoring data. These levels increase in complexity from Level I to Level III based on increasing levels of DEQ approved QA/QC protocols. Definitions of each level and how groups can achieve each of them are outlined below.

**Level I - Not approved by DEQ for assessment.** There is no Quality Assurance Project Plan (QAPP) or Standard Operational Procedures (SOP) on file. Monitoring and/or laboratory analysis does not follow DEQ sampling methods or quality assurance protocols or monitor for parameters that do not have a Virginia Water Quality Standard (<http://www.deq.virginia.gov/wqs>).

- Data may be used by DEQ to identify sites that may need to have DEQ perform follow-up monitoring.
- Data may be used for educational purposes.
- Data can notify DEQ of significant pollution events for agency response.

**Level II - Partially approved by DEQ.** May be using a monitoring method similar to DEQ protocols but not fully approved by DEQ due to difference in sampling or testing methodology. The monitoring group may have a DEQ approved QAPP and/or SOP on file.

- All uses as stated in Level I
- Could be used for 305(b) assessment to identify possible waters with observed effects or waters that appear to be healthy but will need DEQ monitoring data to confirm status (Category 3C or 3D).

**Level III - Approved by DEQ.** Group follows DEQ testing and quality assurance protocols. Field sampling and laboratory testing protocols are approved by DEQ or DEQ approved accrediting authority. Group possesses a DEQ approved QAPP and SOP with no deviation from DEQ approved standardized methods (EPA methods, Standard Methods, etc). Finally, the group must provide calibration and quality control associated information to DEQ when submitting data. This information must meet the specific criteria stated in the QAPP.

- All uses as stated in Level II
- DEQ views this level of citizen data as if DEQ had collected and analyzed the sample. Citizen data that meet Level III criteria will be used in the 305(b) water quality assessment and for 303(d) listing/delisting of impaired waters.

As of December 2006, DEQ had awarded Level III status to 32 of the 94 citizen monitoring organizations who have submitted water quality data to the agency. The desire of many groups to have DEQ use their data, the continued efforts by DEQ to help citizen groups to match DEQ protocols, and the Citizen Monitoring Grant Program, have helped to increase the number of Level III data submissions.

For the 2008 assessment report, DEQ received citizen monitoring data from 1,303 sites. 301 of these sites met Level I requirements, 589 sites met Level II, 333 met Level III for at least one water quality parameter, and 80 had missing or incomplete sample site coordinates. This is the largest amount of citizen monitoring data ever received to date by DEQ. The following citizen monitoring organizations submitted water quality data to DEQ:

Arlington County E. coli Volunteers	Goose Creek Association	RappFLOW
Alliance for the Chesapeake Bay	Highlands Soil and Water Conservation District	Smith Mountain Lake Association
Ashburn Village Monitors	Historic Green Springs, Inc.	StreamWatch
Audubon Naturalist Society	John Marshall Soil and Water Conservation District	Sweet Briar College
Blackwater/Nottoway Riverkeeper	Lake Anna Civic Association	Timberlake Homeowners Association
Chesapeake Bay Governors School (coordinated by the Tidewater RC&D)	Lord Fairfax Soil and Water Conservation District	Upper Rappahannock Watershed Stream Monitoring Program
Clean Virginia Waterways/Longwood University	Loudoun Wildlife Conservancy	Upper Tennessee River Roundtable
Environmental Alliance for Senior Involvement	Mattaponi and Pamunkey Rivers Association	Virginia Save Our Streams Program of the Virginia Division of the Izaak Walton League of America
Friends of Blacks Run	McClure River Restoration Project	
Friends of the Shenandoah River	Randolph Macon College	

The Alliance for the Chesapeake Bay submitted ambient (chemical and physical) data collected by the following affiliate organizations:

Caledon Natural Area	Elizabeth River Project	Leesylvania State Park
Cat Point Creek Group	Friends of Chesterfield's Riverfront	Mason Neck State Park
Cherokee Lake Association	Friends of the Rappahannock Chemical Monitoring Program	Mattaponi Indian Reservation
Chesapeake Bay Foundation, York Chapter	Friends of Scott's Creek	Tidewater Resource Conservation and Development Council
Chesapeake Bay Youth Conservation Corps	George Washington's Birthplace National Monument	Westmoreland State Park
Chippokes State Park	James River Association	York River State Park
Eastern Shore Soil and Water Conservation District	James River Park	

The Friends of the Shenandoah River submitted ambient (chemical and physical) data collected by the following affiliate organizations:

Augusta River Monitors	Friends of the North Fork Shenandoah River	Opequon Watershed Inc.
Friends of Page Valley	Friends of the Shenandoah River	Warren County Water Monitoring Group

The VA SOS program is the largest citizen and benthic macroinvertebrate monitoring program in Virginia. The VA SOS Modified Rocky Bottom Method protocol determines the benthic community health

in higher gradient streams with riffles typical to those found in the western part of Virginia. DEQ considers the VA SOS data submitted Level II because it provides general information on the overall health of a benthic community. Starting in 2006, VA SOS and DEQ have partnered to perform additional studies to see if specific ranges of the VA SOS method closely agree with DEQ's Virginia Stream Condition Index (VSCI). These studies are scheduled to resume in 2008.

In response to requests from citizens located in the eastern part of Virginia, VA SOS also developed a protocol for low gradient, freshwater, non-tidal streams. At the time of this report, DEQ has not approved the low gradient freshwater streams for QA Level II or III.

The Virginia Save Our Streams Program of the Virginia Division of the Izaak Walton League of America submitted benthic macroinvertebrate data collected by the following affiliate organizations:

Amelia County Landfill	Friends of the Rappahannock SOS Monitoring Program	Pedlar River Institute
Bluestone Watershed Committee	Friends of the Rockfish River	Piedmont Environmental Council
Buchanan Citizens Action Group	Goose Creek Association	Radford University Green Team
Buckingham Citizen Action League	Grundy High School Earth Science Class	Reston Association SOS Monitoring Program
Chowan Basin Soil and Water Conservation District	Headwaters Association	Rivanna Conservation Society
Cowpasture River Preservation Association	Holston River Water Quality Monitors	Rivanna River Basin Project
Culpeper Soil and Water Conservation District	Hungry Mother State Park	Roanoke River Monitors
Douthat State Park	John Marshall Soil and Water Conservation District	Skyline Chapter of Trout Unlimited
Elliott Creek Watershed Protection Council	Kittrell Stream Team	StreamWatch
Emory and Henry College	Maury River Middle School	Upper Rappahannock Watershed Stream Monitoring Program
Environmental Education Center	Maury River Monitors	Upper Tennessee Roundtable
Environmentally Concerned Citizens Organization	Middle River Monitors	Virginia's Explore Park
Friends of Page Valley	Mountain Stream Stewards	VT Department of Geosciences
Friends of the North Fork of the Shenandoah River	New River Monitors	Walker Creek Watershed Group
Friends of the North River	North Fork Goose Creek Watershed Committee	Warren County Chapter of the Izaak Walton League
Friends of the Pedlar River	Northern Virginia Soil and Water Conservation District	

Below is an alphabetical summary of the water quality data contributions by citizen monitoring organizations that DEQ included in this report. Additional information is available in a table at the end of this summary and in Appendix D.

The Alliance for the Chesapeake Bay (ACB) coordinates with affiliate organizations in the eastern half of Virginia. ACB volunteers monitor a conventional suite of ambient parameters including dissolved oxygen, temperature, pH, salinity, and water clarity. Trained volunteers monitored at 136 stations and collected 6,353 samples during the six-year data window for this report. Some dissolved oxygen and temperature data met DEQ criteria to assess water quality conditions. Other data not meeting the QA criteria were used to determine if follow-up monitoring is needed.

The Arlington County Volunteer E. Coli Monitors is a partnership with local citizen monitors and the Arlington County Department of Environmental Services. Volunteers collected 87 samples from 10

locations along Four Mile Run in Arlington County using Coliscan® in an effort to identify areas showing high levels of E. coli bacteria. The results were submitted to DEQ to help with Total Maximum Daily Load (TMDL) Implementation Plan (IP) efforts by identifying locations that could benefit from the installation of Best Management Practices (BMP). DEQ included submitted data in this report to determine if follow-up monitoring is needed.

The Audubon Naturalist Society (ANS) monitors benthic macroinvertebrates in the Potomac River Subbasin using the ANS protocol. Trained ANS volunteers monitored 22 stations and participated in 232 sampling events during the data window for this report. DEQ included ANS data in the assessment to determine if follow-up monitoring is needed.

The Chesapeake Bay Governors School, in association with the Tidewater Resource Conservation and Development, monitored for dissolved oxygen, pH, temperature, and turbidity at 12 stations from December 2003 to November 2006. Upon review of calibration logs, quality assurance project plan, and other documents, DEQ will assess dissolved oxygen, pH, and temperature data collected by this organization.

Clean Virginia Waterways, in partnership with Longwood University, collected 207 E. coli samples from 23 stations along the Appomattox River as part of the Appomattox River Water Quality Monitoring Program. Two stations, composed of 18 samples, were not included in the assessment due to missing latitude and longitude information. Upon review of sampling and laboratory procedures, DEQ will assess the E. coli data collected after November 2004.

The Environmental Alliance for Senior Involvement (EASI) monitors water quality in several locations around Virginia and in other states. One EASI chapter in Fauquier County submitted water quality data at one station for dissolved oxygen, temperature, pH, and nutrients. Upon review of the equipment and sampling protocols, 21 temperature observations were used to assess water quality.

The Friends of Blacks Run Greenway, in partnership with James Madison University and several local high schools, conducted an intensive E. coli monitoring program in Blacks Run using Coliscan® test kits. This project was supported through DEQ in an effort to determine potential areas for restoration efforts as part of the Blacks Run TMDL Implementation Plan (IP). Volunteers collected 152 samples at 15 stations and DEQ will use this data to determine if follow-up monitoring is needed.

The Friends of the Shenandoah River (FOSR) monitors ambient water quality for dissolved oxygen, pH, temperature, ammonia, nitrate, and orthophosphate in the Shenandoah River Subbasin. The FOSR submitted water quality data for the above mentioned parameters from June 1, 2004 through December 31, 2006. This submittal coincided with DEQ approving the sampling and analysis methods employed by FOSR volunteers. The data for this period covered 225 sites comprising of 5,306 sample events. Of the data submitted, 68 sample sites composed of 1,100 sample events were not included in this assessment due to missing site coordinates or located within VPDES permitted mixing zones. DEQ is assessing FOSR data for ammonia, dissolved oxygen, pH, temperature, and nitrate in areas designated for drinking water.

The Goose Creek Association (GCA) collected 232 water chemistry, E. coli, and benthic macroinvertebrate samples at 22 stations over the course of this reporting period. GCA volunteers collected benthic macroinvertebrate data using Virginia Save Our Streams protocols and submitted to DEQ via Virginia Save Our Streams. Although pH and temperature results were acceptable for assessment use by DEQ, GCA requested DEQ not use their data directly to assess. Temperature, pH, and E. coli samples were used to determine if follow-up monitoring is needed.

The Headwaters Soil and Water Conservation District (HSWCD) conducted an intensive E. coli monitoring program in Christians Creek using Coliscan® test kits. This project was supported through DEQ in an effort to determine potential sources and areas for restoration efforts as part of the Christians Creek TMDL IP. HSWCD volunteers sampled at 10 stations collecting 49 samples from March 2006 through December 2006. DEQ used this data to determine if follow-up monitoring is needed.

The Historic Green Springs, Inc. conducted monitoring in the York River Basin for temperature, pH, nutrients, and total suspended solids. Trained volunteers monitored seven stations and conducted 108 sampling events in this basin during the data window for this assessment. Temperature readings were used directly to assess water quality and pH, nutrients, and total suspended solids was used to

Final 2008

determine if follow-up monitoring is needed.

The John Marshall Soil and Water Conservation District (JMSWCD) monitored for E. coli bacteria levels along Thumb Run in Fauquier County. JMSWCD staff used Coliscan® test kits to determine general trends in E. coli levels at 10 sample sites comprising 160 sample events. This purpose of monitoring was to track TMDL implementation efforts and identify sites that would benefit from BMP installation. DEQ used the Coliscan results to determine if follow-up monitoring is needed.

The Lake Anna Civic Association collected samples on Lake Anna and its tributaries using a conventional suite of ambient parameters including dissolved oxygen, temperature, pH, E. coli, total phosphorus, and water clarity. Trained volunteers monitored 28 stations and conducted 460 sampling events in this basin during the data window for this report. DEQ is assessing data collected for dissolved oxygen, pH, temperature, total phosphorous, and E. coli for this report.

The Lord Fairfax Soil and Water Conservation District (LFSWCD) monitored for E. coli bacteria levels along Holman's Creek in Shenandoah County. LFSWCD staff used the Coliscan® test kits to determine general trends in E. coli levels at 12 sites comprising of 126 sample events. The purpose of this monitoring was to track TMDL implementation efforts and identify sites that would benefit from BMP installation. DEQ used the results to determine if follow-up monitoring is needed.

The Loudoun Wildlife Conservancy (LWC) monitors benthic macroinvertebrates in Loudoun County using the Audubon Naturalist Society protocol. Trained LWC volunteers monitored 32 stations during 165 sampling events for benthic macroinvertebrates. In addition, the LWC monitored for E. coli at two of their benthic monitoring stations and ten additional stations using Coliscan® test kits covering 118 sampling events to DEQ. DEQ used the benthic and E. coli data to determine if follow-up monitoring is needed.

The Mattaponi and Pamunkey Rivers Association (MPRA) has used Coliscan® test kits to monitor sections of the Mattaponi and Pamunkey Rivers. MPRA volunteers collected 90 E. coli samples from 13 sites to assist DEQ with targeting areas for TMDL implementation efforts. Based on the training and technical assistance provided by DEQ, the agency used the data to determine if follow-up monitoring is needed.

The McClure River Restoration Project (MRRP) is conducting an intensive E. coli monitoring program in the McClure River watershed. DEQ has received data from 13 stations composed of 37 sample events from September 2006 through December 2006. Based on reviewing sampling and laboratory protocols, DEQ used the data to assess water quality.

The Opequon Watershed Inc., an affiliate with the Friends of Shenandoah River, used Coliscan® test kits to monitor in the Opequon Watershed near Winchester, Virginia. Volunteer monitors collected 208 E. coli samples at 25 sites from April through December 2006. Monitoring was done to help track TMDL implementation efforts and identify sites that would benefit from BMP installation. DEQ used the results to determine if follow-up monitoring is needed.

Randolph Macon College located in Ashland, Virginia, has used Coliscan® test kits to monitor nearby Mechumps Run. From September 2005 to October 2006, students collected 106 E. coli samples at 12 sites in an effort to assist DEQ in finding areas of high E. coli concentrations and to track TMDL implementation efforts. Based on training and technical assistance provided by DEQ, the agency used the data to determine if follow-up monitoring is needed.

The Rappahannock Friends and Lovers of Our Watershed (RappFLOW) sampled at 19 stations for dissolved oxygen, pH, temperature, and E. coli bacteria from April to September 2006. Upon review of calibration logs and other quality assurance materials, DEQ used the data in this assessment to determine if follow-up monitoring is needed.

StreamWatch, a member of Virginia Save Our Streams (VA SOS), submitted benthic macroinvertebrate data collected during 272 sample events at 41 stations located around the Rivanna Subbasin. Because StreamWatch follows VA SOS protocols, DEQ used the collected data in this report to determine if follow-up monitoring is needed.

Sweet Briar College monitors a conventional suite of ambient parameters including dissolved

Final 2008

oxygen, temperature, pH, nutrients, water clarity, and E. coli bacteria in several small tributaries that feed into the James River. Students monitored six stations during six sampling events in May and June of 2004. Upon review of sampling and laboratory procedures, DEQ will assess water quality using the submitted E. coli data.

The Timberlake Homeowners Association monitors a privately owned lake just outside of Lynchburg. During this assessment period, volunteers collected dissolved oxygen, pH, temperature, nutrients, and E. coli data at 11 stations covering 114 sample events. Upon review of protocols and methods used by the volunteers, DEQ will assess water quality using this data.

Upper Rappahannock Watershed Stream Monitoring Program collected water chemistry samples from 27 stations consisting of 97 measurements from 2001 to 2002. Upon review of the sample collection and analytical methods, dissolved oxygen, pH, and temperature data were determined acceptable to determine if follow-up monitoring is needed.

The Upper Tennessee River Roundtable (UTRR), collected E. coli samples using Coliscan® at several creeks located around Wise, Virginia. This project was supported through DEQ in an effort to determine potential sources and areas for restoration efforts as part of the Three Creeks TMDL IP. Volunteers collected 68 samples at nine stations from February to November 2006. Based on the training and technical assistance provided by DEQ, the agency is incorporating the data into this report to determine if follow-up monitoring is needed.

The Virginia Save Our Streams Program of the Virginia Division of the Izaak Walton League of America (VA SOS) coordinates with a number of affiliate organizations across Virginia. Trained VA SOS volunteers collecting benthic macroinvertebrate samples using the VA SOS Modified Rocky Bottom Method and submitted data from 241 stations composed of 759 sample events. Due to insufficient or missing site coordinates, 10 sampling stations covering 12 sampling events were not included. DEQ is using the submitted data to determine if follow-up monitoring is needed.



**Citizen Monitoring Data Submitted: Level II and III**

Citizen Monitoring Organizations	Potomac/ Shenandoah Sample		James Sample		Rappahannock Sample		Roanoke Sample		Chowan Sample		Tennessee Sample		Chesapeake Bay Sample		York Sample		New Sample		Unknown Locations Sample		Total Sample	
	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events
Alliance for the Chesapeake Bay	18	737	53	2,844	21	959							19	662	25	1,151					136	6,353
Arlington County Volunteer Monitors	10	87																			10	87
Audubon Naturalist Society	22	232																			22	232
Chesapeake Bay Governors School					12	94															12	94
Clean Virginia Waterways			21	189															2	18	23	207
Environmental Alliance for Senior Involvement	1	21																			1	21
Friends of Blacks Run	15	152																			15	152
Friends of the Shenandoah River	157	4,206																	68	1,100	225	5,306
Goose Creek Association	22	132																			22	132
Headwaters SWCD	10	49																			10	49
Historic Green Springs Inc.															7	108					7	108
John Marshall SWCD					10	160															10	160
Lake Anna Civic Association															28	460					28	460
Lord Fairfax SWCD	12	126																			12	126
Loudoun Wildlife Conservancy	42	284																			42	284
Mattaponi and Pamunkey Rivers Association															13	90					13	90
McClure River Restoration Project											13	37									13	37
Opequon Watershed Inc.	25	208																			25	208
Randolph Macon College															12	106					12	106
RappFLOW					19	65															19	65
StreamWatch			41	272																	41	272
Sweet Briar College			6	6																	6	6
Timberlake Homeowners Association							11	114													11	114
Upper Rappahannock Watershed Stream Monitoring Program					27	97															27	97
Upper Tennessee River Roundtable											9	68									9	68
Virginia Save Our Streams	57	204	60	157	36	209	33	91	1	2	41	73			1	1	12	22	10	12	251	771
<b>Grand Total</b>	<b>391</b>	<b>6,438</b>	<b>181</b>	<b>3,468</b>	<b>125</b>	<b>1,584</b>	<b>44</b>	<b>205</b>	<b>1</b>	<b>2</b>	<b>63</b>	<b>178</b>	<b>19</b>	<b>662</b>	<b>86</b>	<b>1,916</b>	<b>12</b>	<b>22</b>	<b>80</b>	<b>1,130</b>	<b>1,002</b>	<b>15,605</b>

## Other Non-Agency Water Quality Monitoring:

By broadening the scope of our data solicitation beyond citizen monitoring, DEQ is receiving water quality data from an expanding pool of government, private industry, and other non-citizen monitoring organizations. The guidelines for accepting these datasets are the same as with citizen monitoring data. Each organization must show documented sample collection and testing protocols and pass routine inspections and laboratory audits by the agency. Depending on the degree of compliance with the vetting of the sampling methods and test procedures, the data can either be used directly for assessment or provide locations to establish future DEQ sampling sites.

During the past several assessment reports, DEQ received water quality monitoring data from the United States Geological Survey (USGS). The data collected by the USGS follows strict adherence to EPA sampling methods and analytical procedures that are fully approved by DEQ. In addition, the United States Forest Service (USFS) routinely submits benthic macroinvertebrate data. The benthic data collected by the USFS follow standard benthic macroinvertebrate monitoring protocols that are similar to DEQ benthic monitoring methods.

Since the 2004 report, additional agencies have begun submitting water quality data for assessment. Most of the data submitted for the 2008 assessment report comes from various federal, state, and local government agencies and select academic institutions.

For the 2008 assessment report, DEQ received data from 19 non-agency groups which monitored at 2,840 sample sites. 2,394 sites met Level I requirements, 222 met Level II, 173 met Level III for at least one water quality parameter, and 51 had missing sample site coordinates. To date, this is the largest amount of non-agency data received by DEQ. The following private and government organizations submitted water quality data to DEQ:

Abingdon Sewage Treatment Plant	National Park Service- Richmond Battlefield Parks	United States Forestry Service
Chesterfield County Office of Water Protection	National Park Service- Shenandoah National Park	United States Geological Survey
City of Newport News Department of Public Works	Occoquan Watershed Monitoring Laboratory	University of Virginia Shenandoah Monitoring Program
City of Norfolk Department of Public Works	Page County Department of Environmental Services	VDH Beach Program
Cumberland Resources Corporation	Reston Association Lake Monitoring Program	VDH Shellfish Sanitation Program
National Park Service- Fredericksburg and Spotsylvania Military Parks	Tennessee Valley Authority	
National Park Service- National Capital Region Network	United States Environmental Protection Agency	

Below is an alphabetical summary of the water quality data contributions by non-agency organizations that DEQ included in this report. Additional information is available in a table at the end of this summary and in Appendix D.

The Abingdon Sewage Treatment Plant submitted water quality data collected upstream of their facility to DEQ. From January 2001 through December 2006 the staff collected 82 samples from one sample site located upstream of their facility. Submitted data included stream flow, temperature, dissolved oxygen, pH, Biochemical Oxygen Demand (BOD), nutrients, and E. coli bacteria. Upon reviewing sampling procedures and testing protocols, DEQ will assess water quality for temperature, pH, nutrients, and E. coli.

From January 2001 through December 2006, the City of Newport News provided data collected along the Chickahominy River as part of a routine program to test source water used for drinking water. The program collected 979 samples at six stations for dissolved oxygen, pH, temperature, and conductivity. After reviewing the sampling procedures and calibration logs, DEQ will assess water quality for dissolved oxygen, pH, and temperature.

The City of Norfolk Lakes and Reservoirs Program monitors at multiple reservoirs supplying drinking water to the city. From February 2003 to November 2004, staff collected 323 samples from 20 sites. The parameters monitored were dissolved oxygen, pH, temperature, and salinity. Upon review of the equipment and calibration logs, DEQ will assess data for dissolved oxygen, pH, and temperature where calibration of the sampling equipment was determined to be acceptable.

From January 2002 through December 2006, Chesterfield County Office of Water Programs submitted water quality data for 40 stations comprising of 930 samples and consisted of temperature, dissolved oxygen, pH, nutrients, and similar parameters. Upon review of calibration logs and procedures, dissolved oxygen, pH, and temperature data did meet DEQ requirements for inclusion in this report. However, Chesterfield County has requested the agency not use their results for 303(d) listing or delisting but the agency is using the submitted data to identify follow-up monitoring locations.

From August through December 2006, the Cumberland Resources Corporation collected 26 water samples along six sites located near their mining operations in Wise County. The samples analyzed were pH, conductivity, total suspended solids, and osmotic pressure. Upon review of the testing protocols and sampling procedure, DEQ used pH results in this assessment report. Conductivity, total suspended solids, and osmotic pressure were not included because Virginia has not adopted Water Quality Standards for these parameters.

The National Park Service conducts intensive water quality monitoring at several parks located in Virginia. The National Capital Region Network submitted data for water chemistry and benthic macroinvertebrate data from 21 sites located in Virginia near Washington D.C. This park system partnered with Virginia Save Our Streams (VA SOS) and reported benthic macroinvertebrates, using the VA SOS protocol, to VA SOS. Water chemistry data submitted by the park did not meet DEQ QA/QC review and was not included in this report.

The Richmond Area National Battlefield Parks submitted benthic macroinvertebrate data from nine sites. Upon review of the data, DEQ used the results to determine if follow-up monitoring is needed.

The Shenandoah National Park submitted data for dissolved oxygen, pH, temperature, and benthic macroinvertebrates. Macroinvertebrate data collected at 24 sites help DEQ determine if follow-up monitoring is needed.

The Occoquan Watershed Monitoring Laboratory monitors field parameters and total phosphorous at four sites along the Occoquan Reservoir. Trained field and laboratory staff collected 8,796 measurements at various depths at four stations during the six year assessment window. Based on review of field and laboratory protocols, DEQ will include the results to assess water quality at the reservoir.

Page County Department of Environmental Services, conducted an intensive E. coli monitoring program in Hawksbill Run using Coliscan® Easgyl™. This project was supported through DEQ in an effort to determine potential sources and areas for restoration efforts as part of the Hawksbill Run TMDL IP. From September 2005 through December 2006, Page County staff sampled at 18 stations in Hawksbill Creek collecting 183 samples. DEQ included submitted data in this report to determine if follow-up monitoring is needed.

The Tennessee Valley Authority has conducted reservoir monitoring along the South Fork of the Holston River. The monitoring consisted of E. coli bacteria sampling at two sites between the months of May to June from 2002 to 2006. Sampling and analysis protocols followed standard methods and DEQ used the data to assess water quality.

From November 2005 through December 2006, the United States Environmental Protection Agency submitted water chemistry and benthic macroinvertebrate data collected at four sites along Accotink Creek in Fairfax County. Benthic macroinvertebrate samples followed EPA protocols and results were equated to Virginia Stream Condition Index (VSCI) and are acceptable for DEQ to include in this report. Water chemistry data provided to DEQ did not contain associated quality assurance information and was not included in this report.

From April 2001 to July 2006, the United States Forest Service (USFS) conducts an intensive

Final 2008

benthic macroinvertebrate study in and around the national forests in Virginia. The USFS monitored at 182 stations and collected 248 benthic macroinvertebrate samples. However, due to insufficient or missing site coordinates, 51 stations with data from 62 sampling events were not included in this report. Upon review of sampling protocols, DEQ used the benthic macroinvertebrate data for assessing water quality.

From January 1, 2001 to September 26, 2006, the United States Geological Survey (USGS) submitted water quality data for 58 stations located in the eastern and central portions of Virginia. USGS staff collected and submitted data from 4510 sample events. The stations monitored many ambient water quality parameters from dissolved oxygen and pH to dissolved metals. The USGS follows EPA protocols for sampling and analysis of results. USGS monitoring data identified as having a Virginia Water Quality Standard were used by DEQ to assess water quality at these sample sites.

From October 2003 to September 2004, the University of Virginia conducted an intensive pH study to track water quality along the Shenandoah and Upper James River watersheds. Trained staff monitored for pH at 20 stations collecting 240 samples. This data meets DEQ criteria for pH analysis and the data are included in this report.

From May to October each year, the Virginia Department of Health (VDH) collects Enterococci bacteria samples from public beaches located in the eastern half of Virginia. For this assessment report, VDH staff collected 3,335 bacteria samples from 51 stations located at public beaches and submitted the results to DEQ. Due to VDH using the same sampling methods and laboratory procedures used by DEQ, VDH results were used by DEQ to assess water quality.

### Non-Agency Data Submitted: Level II and Level III

Other Non-Agency Groups	Potomac/ Shenandoah		James		Rappahannock		Roanoke		Chowan		Tennessee		Chesapeake Bay		York		New		Unknown Locations		Total	
	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events
Abingdon Sewage Treatment Plant											1	82									1	82
Chesterfield County Office of Water Protection			40	930																	40	930
City of Newport News			6	979																	6	979
City of Norfolk			18	290					2	33											20	323
Cumberland Resource Corporation											6	26									6	26
Occoquan Watershed Monitoring Laboratory	4	8,796																			4	8,796
Page County Department of Environmental Service	18	183																			18	183
Tennessee Valley Authority											2	71									2	71
United States Environmental Protection Agency	4	15																			4	15
United States Forest Service	34	60	54	76							21	25					22	25	51	62	182	248
United States Geological Survey	19	3,811	27	342	7	123							3	16	2	218					58	4,510
National Park Service	24	88	9	18																	33	106
Virginia Department of Health- Beach Monitoring Program	1	72	8	514					9	594			31	2,043	2	112					51	3,335
University of Virginia	13	150	7	90																	20	240
<b>Grand Total</b>	<b>117</b>	<b>13,175</b>	<b>169</b>	<b>3,239</b>	<b>7</b>	<b>123</b>	<b>0</b>	<b>0</b>	<b>11</b>	<b>627</b>	<b>30</b>	<b>204</b>	<b>34</b>	<b>2,059</b>	<b>5</b>	<b>330</b>	<b>22</b>	<b>25</b>	<b>51</b>	<b>62</b>	<b>446</b>	<b>19,844</b>

## Current Efforts to Support Citizen and Non-Agency Surface Water Quality Monitoring

DEQ is committed to expanding the use of non-agency surface water quality monitoring data in future water quality assessment reports. This is primarily due to an increasing need for additional water quality data and the growth in the sophistication in water quality monitoring by sources outside of DEQ. During the past couple of years, DEQ has been working on several projects to increase the amount and quality of non-agency data available.

One project currently underway is a voluntary monitoring initiative for wastewater treatment plants and other facilities that have a Virginia Pollutant Discharge Elimination System (VPDES) or similar permit. This initiative involves DEQ asking VPDES permit holders to voluntarily provide water quality collected upstream of the facility's discharge or water intake area.

The reasoning behind this initiative is that many VPDES facilities have qualified staff and laboratory capability due to their routine monitoring of treatment plant effluent. Facilities can volunteer to help sample upstream sites as part of their routine monitoring schedule and submit data to DEQ on a regular basis. A few facilities were approached in 2005 to begin monitoring. Through this initial effort, two facilities are actively participating and their data were incorporated into this report. In 2008, we will continue to reach out to partner with new facilities who might wish to become involved in this initiative.

In the fall of 2006, DEQ developed Guidance Memo No. 06-2010 to outline how citizen and other monitoring groups can qualify their benthic macroinvertebrate monitoring data as Level III. This guidance was in response to the request of several citizen organizations that monitor for benthic macroinvertebrates to have their data used directly by DEQ. With this new guidance, citizen and non-agency monitoring organizations now have another avenue to qualify for Level III assessments. A copy of this guidance is available online at <http://www.deq.virginia.gov/waterguidance/pdf/062010.pdf>.

In 2007, DEQ unveiled a new online database application for citizen monitoring and other non-agency groups to submit water quality data. This application provides a centralized location to submit, store, and retrieve non-DEQ water quality data. In addition, the application allows the public to view most of the water quality data that are submitted to the agency. The database is located at <http://www.deq.virginia.gov/easi/mdpro/public.html>. In 2005, DEQ, in partnership with the Virginia Water Monitoring Council (VWMC), helped to develop a web-enabled application for the public to find contact information on water quality monitoring organizations across Virginia. With the development of the non-agency database, the VWMC application was upgraded and now allows users to see a map of sample locations found in the database application and provides an alternative way for the public to access citizen and non-agency water quality data at those sites. The VWMC application is accessible by going to their website <http://www.vwrrc.vt.edu/vwmc> or by visiting the DEQ website <http://gisweb.deq.virginia.gov> and click on the link titled *Community Monitoring Efforts*.

Through these new and continuing efforts, DEQ is able to utilize data that was previously unavailable or unknown to the agency. DEQ values the contributions of non-agency monitoring staff and citizen volunteers and will continue to support their monitoring efforts however possible. With assistance from these organizations, DEQ is increasing monitoring coverage in Virginia.

Additional information is available on the DEQ citizen monitoring webpage: <http://www.deq.virginia.gov/cmonitor>.

### You May Also Contact:

James Beckley  
Water Quality Data Liaison  
PO Box 1105  
Richmond, Virginia 23219  
(804) 698-4025  
[jebeckley@deq.virginia.gov](mailto:jebeckley@deq.virginia.gov)